Quick-Scanning EXAFS

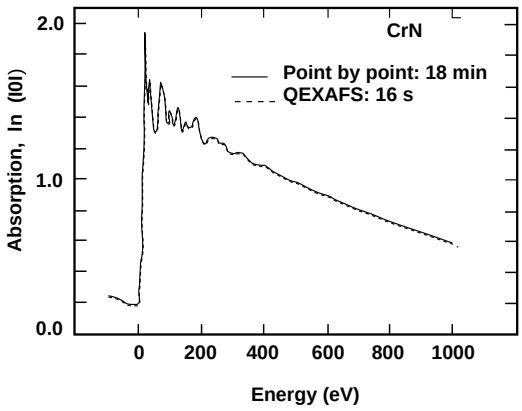
Material bonding and structural information in seconds

We have developed a quick-scanning EXAFS (extended x-ray absorption fine structure) technique (we call it QEXAFS) that uses intense synchrotron radiation to characterize material bonding and structure. With our technique, we can record element-specific, x-ray absorption spectra in a matter of seconds. We developed this capability, the only U.S. QEXAFS beamline, at the Stanford Synchrotron Radiation Laboratory. We have used the technique to investigate technologically interesting materials such as aerogels and materials processing such as combustion synthesis.

APPLICATIONS

- *Survey scan*
- *In situ catalysis studies*
- *Phase transformations*
- *Thin-film deposition*
- *Combustion synthesis*
- *Multiple-edge scans*

The figure shows two chromium k-edge EXAFS spectra of chromium nitride, which has a simple rock salt NaCl structure with good EXAFS oscillations at a relatively high k-value, even at room temperature. The conventional point-by-point scan (solid curve) required 18 minutes; the QEXAFS scan (dotted curve) required only 16 seconds—with no sacrifice of signal-to-noise ratio in the EXAFS region.



Chromium K-edge EXAFS spectra obtained by a conventional point-by-point scan (solid curve) and by QEXAFS (dotted curve).

QEXAFS permits real-time, x-ray spectroscopic characterization of material properties and processing in seconds. It provides an atom-by-atom diagnostic of chemical structure and reaction path as the reaction proceeds. Installation was a one-time investment, and the facility can be controlled by software. Its availability enables not only a more efficient use of beam time (by eliminating dead time between data points) but also a quicker turnaround of measurements for industrial processes.

Availability: The QEXAFS is operational now and can be used to provide rapid turnaround, spectroscopic information for catalytic and other processes.

Experimental capabilities

- Detection modes
  - — Transmission
  - — Fluorescence
  - — E-yield
  - — Glancing angle
- Sample types
  - — Bulk, dilute, and powder
  - — Thin films
  - — Surfaces (free and buried)
- Time resolution: a few seconds
  - — Full EXAFS scans (1000 eV) in approximately 20 s
  - — XANES scans (100 eV) in approximately 2 s

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